

Amendment to the Claims

1. (Currently Amended) A process for combined thermal and catalytic treatment of heavy petroleum in a slurry phase counterflow reactor, which process comprises:

- a) introducing a liquid feedstock at a top of a reactor vessel to a gas phase thermal reaction zone and thermally reacting said liquid feedstock;
- b) injecting a gas comprising hydrogen near a bottom of said reactor vessel in a catalytic reaction zone;
- c) passing said liquid from said gas phase thermal reaction zone to a liquid phase thermal reaction zone in said reactor vessel below and in communication with said gas-phase thermal reaction zone and thermally reacting said reacted liquid therein;
- d) passing said reacted liquid from said liquid phase thermal reaction zone to a catalytic reaction zone below said liquid phase thermal reaction zone and hydrogenating ~~chemically reacting~~ said reacted liquid therein; and
- e) dispersing said hydrogen through said catalytic reaction zone, through said liquid phase thermal reaction zone and through said gas-phase zone and thereafter separating said hydrogen along with gaseous hydrocarbon products from said thermal and chemical reactions.

2. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 including the additional steps of:

withdrawing heavy unconverted residual product from said bottom of said reactor vessel;

directing at least a portion of said heavy residual product removed to a catalyst addition system having a buffer tank; and

introducing catalyst to said reactor vessel from said catalyst addition system to said catalytic reaction zone.

3. (Currently Amended) A process for combined thermal and catalytic treatment as set forth in Claim 1 wherein said hydrogen gas is injected ~~dispersed by injecting~~ into said reactor vessel at said catalytic reaction zone and ~~bubbling~~ said hydrogen gas is dispersed through said vessel.

4. (Currently Amended) A process for combined thermal and catalytic treatment as set forth in Claim 1 wherein said hydrogen gas is injected at a temperature exceeding the temperature of said catalytic reaction zone ~~hot~~.

5. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 including the additional step of encouraging mixing of said liquid in said liquid phase thermal reaction zone through the use of a plurality of vertical baffles.

6. (Currently Amended) A process for combined thermal and catalytic treatment as set forth in Claim 1 including the additional step of filtering said withdrawing hydrogen gas with gaseous hydrocarbon ~~hydrogen~~ product through a filter to remove solids.

7. (Currently Amended) A process for combined thermal and catalytic treatment as set forth in Claim 1 including the additional step of detecting a liquid level detector to ~~monitor~~ the level of said liquid in said liquid phase thermal reaction zone in said reactor vessel.

8. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 including the additional, initial step of passing said liquid feedstock in heat exchange with said withdrawing hydrogen gas and hydrocarbon product to heat said liquid feedstock.

9. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 wherein said step of introducing liquid feedstock to a top of a reactor vessel is below a porous metal filter screen.

10. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 wherein said step of introducing liquid feedstock at said top of said reactor vessel is through a nozzle.

11. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 including the additional step of separating said withdrawn hydrogen gas from said gaseous hydrocarbon product and recirculating through said catalytic zone.

12. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 including controlling and monitoring pressure by a pressure let down system.
13. (Original) A process for combined thermal and catalytic treatment as set forth in Claim 1 wherein pressure in said reactor vessel is maintained at 1500-2000 PSIG and temperature is maintained at 450⁰F-850⁰F.
14. (Withdrawn) A slurry phase counter flow reactor for combined thermal and catalytic treatment of heavy petroleum, which reactor comprises:
- a reactor vessel having a gas-phase thermal reaction zone, a liquid phase thermal reaction zone, and a catalytic reaction zone;
 - a feedstock inlet in communication with said gas-phase thermal reaction zone;
 - a hydrogen-containing gas inlet in communication with said catalytic reaction zone;
 - an unconverted liquid and solid recovery outlet in communication with said catalytic reaction zone; and;
 - a hydrogen-containing gas and gaseous hydrocarbon product outlet in communication with said gas-phase thermal reaction zone.
15. (Withdrawn) A slurry phase counter flow reactor for combined thermal and catalytic treatment petroleum as set forth in Claim 14 including a catalyst addition system.

16. (Withdrawn) A slurry phase counter flow reactor for combined thermal and catalytic treatment of heavy petroleum as set forth in Claim 15 wherein said catalyst addition system includes an inlet in communication with said liquid bottom product recovery outlet, a pump, a buffer tank, and an outlet in communication with said catalytic reaction zone of said reactor.

17. (Withdrawn) A slurry phase counter flow reactor for combined thermal and catalytic treatment of heavy petroleum as set forth in Claim 14 wherein said hydrogen-containing gas is substantially hydrogen.

18. (Withdrawn) A slurry phase counter flow reactor for combined thermal and catalytic treatment of heavy petroleum as set forth in Claim 14 wherein said hydrogen-containing gas is hot.